

## Monopolistic Competition

*Monopolistic competition* is an appropriate name for this important market structure. There is competition because there is a large number of firms producing similar but not identical products. Each firm has some monopoly power over price because its product is different from others with which it is competing. Each monopolistically competitive firm faces a downward sloping demand (D) curve so it has to reduce its price to have consumers buy more of its product. This means it has a downward sloping marginal revenue (MR) curve that lies below its D curve. In fact, the revenue graph of a monopolistically competitive firm looks like the revenue graph of a monopoly.

A monopolistically competitive firm is similar to a perfectly competitive firm because while it can earn a positive total profit in its short-run equilibrium, it will break even in its long-run equilibrium. It is different from a monopoly in this regard because a monopoly can maintain a positive total profit in the long run as long as it has barriers to entry that prevent other firms from coming into the market.

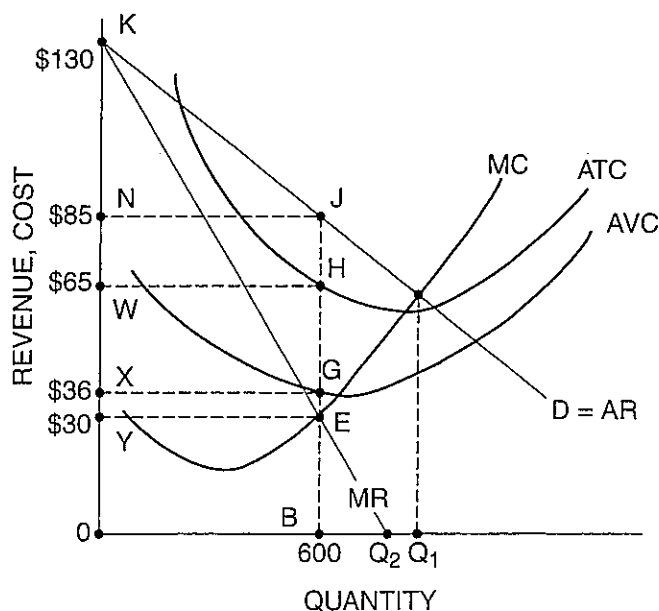
### Part A: Short-Run Equilibrium of a Monopolistically Competitive Firm

A monopolistically competitive firm is in short-run equilibrium when it produces the output where marginal revenue equals marginal cost ( $MR = MC$ ). Its optimal price is found on its demand curve at this output level. Like other firms, the firm will shut down if at its best output level, its total revenue is less than its total variable cost. Figure 3-16.1 shows a monopolistically competitive firm in short-run equilibrium with an output of 600 units per period. Answer the questions that follow the graph.



Figure 3-16.1

#### A Monopolistically Competitive Firm in Short-Run Equilibrium



1. What price will the firm charge for its profit-maximizing output?  
\$85
2. What are the dollar values and coordinates of these items at the output of 600 units?
  - (A) Total revenue  $(\$85)(600) = \$51,000$ , *OBJN*
  - (B) Total cost  $(\$65)(600) = \$39,000$ , *OBHW*
  - (C) Total profit  $(\$20)(600) = \$12,000$ , *WHJN*
  - (D) Average profit  $(\$85 - \$65) = \$20$ , *HJ*
  - (E) Marginal profit  $(\$30 - \$30) = \$0$ , *no gap between MR and MC curves at 600*
3. What is the value of the firm's total fixed cost at 600 units? What is the value of its total fixed cost at 0 units?  
At  $Q = 600$ ,  $TFC = (600)(\$65 - \$36) = \$17,400$ . *This is the value of TFC at all output levels including  $Q = 0$ .*
4. Should this firm shut down? Why?  
*No. It is earning a positive total profit. It would only shut down if it were making a loss and TR were less than TVC.*
5. On the horizontal axis, indicate by  $Q_1$  the output level society would like this firm to produce. Why does the firm not want to produce  $Q_1$ ?  
 *$Q_1$  is the output level at which  $P = MC$ , or where the D curve intersects the MC curve. The monopolistically competitive firm does not want to produce  $Q_1$  because those units between 600 and  $Q_1$  have  $MR < MC$  which means they will reduce the firm's total profit.*
6. On the horizontal axis, indicate by  $Q_2$  the output level at which this firm would maximize its total revenue. Why does the firm not want to produce  $Q_2$ ?  
 *$Q_2$  is the output level at which  $MR = 0$ . The monopolistically competitive firm does not want to produce  $Q_2$  because those units between 600 and  $Q_2$  have  $MR < MC$  which means they will reduce the firm's total profit.*
7. What are the dollar value and the coordinates of consumer surplus when the firm maximizes its total profit?  
 $CS = (0.5)(600)(\$130 - \$85) = \$13,500$   
 $CS = \text{triangle NJK}$

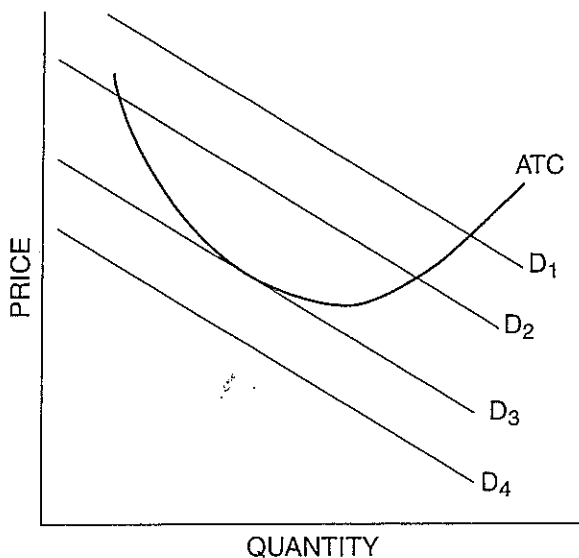
### Part B: Movement from Short-Run Equilibrium to Long-Run Equilibrium

If firms in a monopolistically competitive market are earning positive economic profits, other firms have an incentive to enter this market. As they do so, each firm's share of the total market demand gets smaller and smaller. This means the demand curve facing a monopolistically competitive firm shifts to the left. This process continues until all firms remaining in the industry break even. Outside firms then will no longer have an incentive to enter the market, and existing firms will have no reason to leave because they are receiving their normal profit. Figure 3-16.2 shows the demand and average total cost curves for a typical firm in the monopolistically competitive market for sport shirts.



Figure 3-16.2

#### Movement of a Monopolistically Competitive Firm to Long-Run Equilibrium



8. If the demand curve for this firm is  $D_1$ , is the firm earning positive total profit? If so, will other firms enter the market? What will this do to this firm's share of the market demand?

*Yes, the firm is earning positive total profit because demand (average revenue) is greater than average total cost. Other firms will enter the industry and this firm's share of the market demand will decrease.*

9. If this firm's demand decreases from  $D_1$  to  $D_2$ , will the firm earn a positive total profit? What will happen to this firm's share of the market demand?

*Yes, the firm is earning positive total profit because demand (average revenue) is greater than average total cost. Other firms will enter the industry and this firm's share of the market demand will decrease.*

10. Assume the demand facing the firm drops from  $D_2$  to  $D_4$ . Will it earn a positive total profit? If some other firms in the industry are in a similar situation, what will happen to the number of firms in the industry? What will happen to this firm's share of the market demand?  
*No, the firm will earn a loss because demand (average revenue) is less than average total cost. Some firms will leave the industry over time and this will increase this firm's share of the market demand.*
11. Suppose this firm's demand shifts from  $D_4$  to  $D_3$ . Is this firm making a positive total profit or a loss? If this is the condition for other firms as well, will firms enter or leave the market?  
*The firm is breaking even because demand (average revenue) is equal to average total cost. If all firms are breaking even, the industry is in long-run equilibrium and firms will neither enter nor exit the market.*

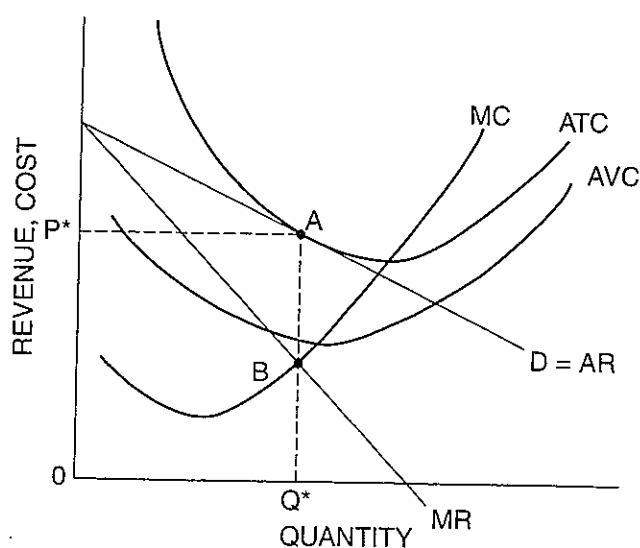
### Part C: Evaluation of a Monopolistically Competitive Firm in Long-Run Equilibrium

When a monopolistically competitive firm is in long-run equilibrium, it will break even or earn \$0 in total economic profit. Because it is receiving its normal profit, it is doing as well with its resources here as it would in its best alternative. Thus, the firm has no incentive to leave the industry. Figure 3-16.3 illustrates a monopolistically competitive firm in long-run equilibrium with quantity  $Q^*$  and price  $P^*$ .

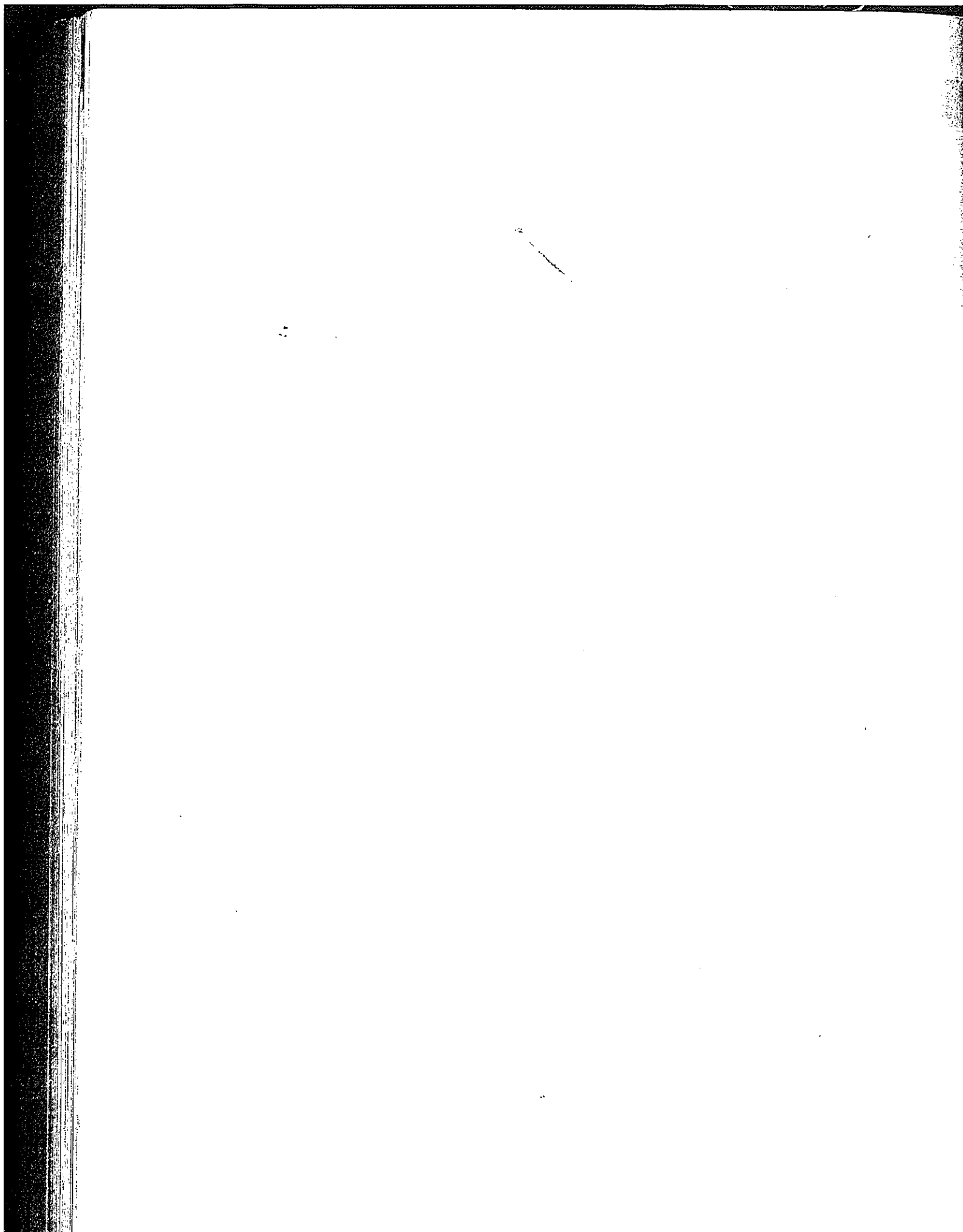


Figure 3-16.3

#### A Monopolistically Competitive Firm in Long-Run Equilibrium



12. If you were asked to draw a graph of a monopolistically competitive firm in a position of long-run equilibrium, there are two conditions you must show with your graph at the profit-maximizing output.
- (A) At  $Q^*$ , the firm's average revenue (or price) must be (*greater than / equal to / less than*) its average total cost. This is shown by drawing the demand curve tangent to the ATC curve at point A.
- (B) At  $Q^*$ , the firm's marginal revenue must be (*greater than / equal to / less than*) its marginal cost. This is shown by drawing your MR curve through the MC curve at  $Q^*$  at point B.
13. Is a monopolistically competitive firm productively efficient when it is in long-run equilibrium? Explain.  
*No, because its price is greater than the minimum value on its average total cost curve. Consumers are not getting the product at the lowest possible price.*
14. Is a monopolistically competitive firm allocatively efficient when it is in long-run equilibrium? Explain.  
*No, because its price is greater than its marginal cost. Society would like the firm to produce more output.*
15. Is the demand curve facing a monopolistically competitive firm more or less elastic than the demand curve facing a monopoly? Why?  
*It is more elastic because the monopolistically competitive firm has many substitute products available in the market.*
16. What are the characteristics of a monopolistically competitive market? What are two examples of such a market?  
*There are many firms producing similar but not identical products. Entry and exit in the market are relatively easy. Each firm has some control over its price because its product is not identical to other firms' products. Advertising is important in such a market. Examples would include retail clothing stores and restaurants.*



## Game Theory

*Strategic thinking is the art of outdoing an adversary, knowing that the adversary is trying to do the same to you.* Dixit and Nalebuff\*

Game theory is used to explain how two or more players make decisions or choose actions when their actions (or strategies) affect each participant. Each player determines his or her best response to the possible actions of every other player. According to game theory, a player's choice of strategy depends on the strategy the player thinks other players will choose. In some cases, these strategies reinforce each other, but in other cases they do not. When the chosen strategies reinforce each other, the game achieves what is called a *Nash Equilibrium*. The Nash Equilibrium is named after John F. Nash, Jr., who was co-winner of the 1994 Nobel Prize in Economics for his work in this area and the subject of the 2001 movie, *A Beautiful Mind*.

Game theory provides insights into how business and government decisions are made and has numerous real-world applications. For example, game theory has helped economists analyze antitrust policy, tariff wars, and auctioning behavior. This lesson is an introduction to the basic elements of game theory. As you do the math, think about the implications of the results.

### Part A: The Basic Elements of Game Theory

The three basic elements of a game are

- (A) the players,
- (B) the strategies available to each player,
- (C) the payoffs each player receives.

These three elements are summarized in a table called a *payoff matrix*. A payoff matrix describes the payoffs to each player for combinations of given strategies. Here is an example of a payoff matrix:

		Coke	
		Advertise	Don't Advertise
Pepsi	Advertise	80, 80	120, 45
	Don't Advertise	45, 120	100, 100

The first number in each square refers to the payoff for the row (horizontal) player, here Pepsi. The second number in each square refers to the payoff for the column (vertical) player, here Coke. The numbers represent the profit (in \$ millions) for Pepsi and Coke.

\*Avinash K. Dixit and Barry J. Nalebuff, *Thinking Strategically: The Competitive Edge in Business, Politics, and Everyday Life* (New York: W.W. Norton, 1991), p. 409.

In this game:

- (A) The players are Pepsi and Coke.
- (B) Here are the strategies available to each player:
  - Pepsi, as the row player, can choose either Advertise or Don't Advertise.
  - Coke, as the column player, can choose either Advertise or Don't Advertise.
- (C) The payoffs each player receives:
  - If Pepsi chooses Advertise and Coke chooses Advertise, Pepsi earns 80 and Coke earns 80.
  - If Pepsi chooses Advertise and Coke chooses Don't Advertise, Pepsi earns 120 and Coke earns 45.
  - If Pepsi chooses Don't Advertise and Coke chooses Advertise, Pepsi earns 45 and Coke earns 120.
  - If Pepsi chooses Don't Advertise and Coke chooses Don't Advertise, Pepsi earns 100 and Coke earns 100.

In some games, one or more players can have a *dominant strategy*. A dominant strategy is the best strategy for a player regardless of the strategy chosen by the other player.

1. To see if Pepsi has a dominant strategy, answer these questions based on the information in the payoff matrix.
  - (A) If Coke decides to advertise, Pepsi's best strategy would be (Advertise / Don't Advertise).
  - (B) If Coke decides not to advertise, Pepsi's best strategy would be (Advertise / Don't Advertise).
  - (C) Is Pepsi's best strategy the same regardless of whether Coke advertises or doesn't advertise? Does this mean Pepsi has a dominant strategy?  
*Yes, Pepsi's best strategy is to Advertise regardless of what Coke does. Pepsi has a dominant strategy of Advertise.*
2. To see if Coke has a dominant strategy, answer these questions based on the information in the payoff matrix.
  - (A) If Pepsi decides to advertise, Coke's best strategy would be (Advertise / Don't Advertise).
  - (B) If Pepsi decides not to advertise, Coke's best strategy would be (Advertise / Don't Advertise).
  - (C) Is Coke's best strategy the same regardless of whether Pepsi advertises or doesn't advertise? Does this mean Coke has a dominant strategy?  
*Yes, Coke's best strategy is to Advertise regardless of what Pepsi does. Coke has a dominant strategy of Advertise.*
3. Do the profit values in the payoff matrix make sense? Why would Pepsi's profit be much higher than Coke's profit when Pepsi advertises and Coke does not? Why could both companies' profit be higher if they both don't advertise compared to if they both do advertise?  
*If Pepsi advertises and Coke does not, Pepsi will attract some consumers from Coke. This would increase Pepsi's profit and reduce Coke's profit. Since advertising can be very expensive, it is possible that if both companies do not advertise, their profits could be higher than if they both did advertise.*



A *dominated strategy* yields a lower payoff than at least one other strategy. In this game, the dominated strategy for Pepsi is Don't Advertise; it is dominated by Advertise. Regardless of the strategy selected by Coke, Pepsi gains more by choosing Advertise. If Pepsi chooses Don't Advertise, the payoff is 45, while a strategy of Advertise has a payoff of 80. Since 45 is less than 80, the dominated strategy is Don't Advertise.

The dominated strategy for Coke is Don't Advertise; it is dominated by Advertise. If Coke chooses Don't Advertise, Coke receives 45 if Pepsi chooses Advertise and 100 if Pepsi chooses Don't Advertise. Since 45 is less than 100, the dominated strategy for Coke is Don't Advertise.

A *Nash Equilibrium* exists when each player is doing his/her best, given what the other player is doing. It is a combination of strategies for each player, such that each chooses his/her best response to the other's strategy choice. In this game, the Nash Equilibrium is both players deciding to Advertise. Although in this example both Coke and Pepsi select the same strategy, in a Nash Equilibrium the players do not have to select the same strategy.

A Nash Equilibrium is similar to a market equilibrium in that there is no incentive for producers and consumers to change from the equilibrium price. Thus a Nash Equilibrium is an "enforceable" equilibrium because the firms do not have an incentive to cheat as they might in a cartel.

Other economic examples of game-theory applications are decisions by firms about what price to charge, whether to enter a market, where to locate, and what kind of product or quality level to produce; decisions by a central bank on monetary policy actions; and decisions by a nation on the optimal tariff policy.

## Part B: The Prisoner's Dilemma Game

One classic application of game theory is the *prisoner's dilemma game*. Prisoner's dilemma games are games in which each player has a dominant strategy; and when both players play the dominant strategy, the payoffs are smaller than if each player played the dominated strategy. The dilemma is how to avoid this bad outcome.

The basics of the prisoner's dilemma game are as follows: two prisoners, Charles and Frances, have the option to confess or not confess to a crime they committed. The prosecutor has only enough information to convict both criminals of a minor offense and is, therefore, relying on a confession. The minor offense carries one year in jail. The prisoners are questioned in different cells, without the ability to communicate. They are told that if one prisoner confesses while the other remains silent, the prisoner confessing will go free and the prisoner remaining silent will serve 20 years in jail. If both prisoners confess, both prisoners will serve three years in jail.

If a player goes free, the payoff is 0. If a player serves one year in jail, the payoff is -1. If a player spends 20 years in jail, the payoff is -20. Use these numbers in your payoff matrix. Note that the negative numbers come from losing years of freedom.

4. Determine the three basic elements of the game.

(A) The players: *Charles and Frances*

(B) The strategies for each player: *Confess or Not Confess*

(C) The payoffs for each player: *If one confesses, he or she goes free, and the other prisoner gets 20 years in jail. If both confess, both get three years in jail. If neither confess, both get one year in jail.*

5. Create a payoff matrix for the prisoner's dilemma game.

		Frances	
		Confess	Not Confess
Charles	Confess	-3, -3	0, -20
	Not Confess	-20, 0	-1, -1

6. Are there dominant strategies? Explain.

*Charles and Frances both have Confess as a dominant strategy. This is each prisoner's best strategy no matter what the other prisoner decides to do.*

7. Identify any dominated strategies. Explain.

*Not Confess is a dominated strategy for both Charles and Frances. This strategy gives a less desirable outcome than the strategy of Confess for each prisoner.*

8. Is there a Nash Equilibrium? Explain.

*Yes, the Nash Equilibrium is for both prisoners to Confess.*

### Part C: Variation of the Prisoner's Dilemma Game

You are in a class with one other student. It is the end of the semester, and final exams are in a week. Your teacher has said the final exam will be graded so that anyone who scores the class average on the final exam will receive a "B" in the class. Anyone who scores above the average will receive an "A" in the class, and anyone who scores below the average will fail the class. You would certainly score higher on the exam than the other student. You and the other student have made an agreement not to take the final exam so that the class average is zero and you both receive "B" grades.

9. Determine the three basic elements of the game.

(A) The players: *You and the Other Student*

(B) The strategies for each player: *Take the Exam or Not Take the Exam*

(C) The payoffs for each player: *If both of you take the exam, you receive an A and the other student receives an F. If both of you do not take the exam, you both receive a B. If you take the exam and the other student does not take the exam, you receive an A and the other student receives an F. If the other student takes the exam and you do not take the exam, you receive an F and the other student receives an A.*

10. Create a payoff matrix for this game.

		Other Student	
		Take the Exam	Not Take the Exam
You	Take the Exam	A, F	A, F
	Not Take the Exam	F, A	B, B

11. Do you have a dominant strategy? Explain.

*Yes, Take the Exam is my dominant strategy because it is my best choice no matter what strategy the other student chooses.*

12. Using a four-point scale (A = 4, B = 3, C = 2, and D = 1), which choice results in the highest class GPA?  
*The highest class GPA will result if neither student takes the exam. If neither student takes the exam, each student will receive a B which results in 6 grade points, or an average GPA of 3.0 per student. Each of the other three strategy combinations will produce one A and one F for a total of 4 grade points, or an average GPA of 2.0 per student.*

If you finished Parts B and C correctly, you will realize that when each player chooses his or her dominant strategy, the result is unattractive to the group.

The key to avoiding the prisoner's dilemma outcome of lower payoffs for both players is to find a way for players to credibly commit to playing a dominated strategy. Merely having both prisoners agree to Not Confess or both students to Not Take the Exam will not work. This results because it is always optimal for Prisoner 1 (or Prisoner 2) to still play the Confess strategy, and it is always optimal for the better student to play the Take the Exam strategy. One possible way to have credible commitment in the prisoner's dilemma game would be to have both prisoners reveal another past crime they committed, thus ensuring that if they confess to this crime, the other prisoner will have additional information to punish the prisoner who cheats on an agreement to not confess.

One way to do this is to form a *cartel*. A cartel is a coalition of firms that coordinate their decisions to reach a more optimal solution for all members of the group by finding ways to credibly commit players to play their dominated strategies. Cartels, however, are not always successful in maintaining their agreements because there may be an incentive for a member to cheat on the cartel.

### Part D: What Should These Firms Do?

There are two firms that produce fiberglass canoes. Both River Queen and Ace Current must decide whether to market a Premium canoe or a Regular canoe. The profit of a firm depends on the type of canoe produced by the other firm. In this chart, the first value is the profit of River Queen, and the second value is the profit of Ace Current. The firms make their decisions simultaneously in a one-period situation. (The values in the chart are thousands of dollars.)

		Ace Current	
		Premium	Regular
River Queen	Premium	\$400, \$100	\$450, \$200
	Regular	\$150, \$400	\$200, \$150

13. Does River Queen have a dominant strategy? What decision will River Queen make?  
*River Queen has a dominant strategy. If Ace Current produces a Premium canoe, River Queen earns a profit of \$400,000 by making a Premium canoe compared to only \$150,000 by making a Regular canoe. If Ace Current produces a Regular canoe, River Queen earns a profit of \$450,000 by making a Premium canoe compared to only \$200,000 by making a Regular canoe. No matter what Ace Current decides to do, River Queen has a higher profit if it produces the Premium canoe, so that is River Queen's dominant strategy.*
14. Does Ace Current have a dominant strategy? What decision will Ace Current make?  
*Ace Current does not have a dominant strategy because its optimal strategy depends on the choice made by River Queen. If River Queen produces a Premium canoe, Ace Current's best strategy is to produce a Regular canoe. But if River Queen produces a Regular canoe, the payoff matrix shows Ace Current should produce a Premium canoe. Assuming Ace Current knows that River Queen has a dominant strategy of a Premium canoe, Ace Current will know its best strategy is to produce a Regular canoe.*
15. Is there a Nash Equilibrium?  
*Yes, River Queen will produce a Premium canoe and Ace Current will produce a Regular canoe. Each firm will be doing its best, given what the other firm is doing.*

### Part E: Questions

16. Is the Coke and Pepsi advertising game a prisoner's dilemma game? Explain why or why not.  
*Yes, it is optimal for both players to play their dominated strategies and be at the Don't Advertise/Don't Advertise corner, earning 100 each.*
17. Interpret "standing at a concert" in terms of the prisoner's dilemma game.  
*If one person stands, he or she gets a better view of the concert. If the person in front of someone stands, then that person's best response is also to stand, or he or she will not be able to see the concert. However, if all people sat, then everyone would be able to see the concert and would not get tired standing.*
18. Explain at least one way the optimal outcome for players, which would be for all players to play the dominated strategy, can be reached in Question 17. What are the possible commitment problems?  
*The concert hall could require people at the concert to remain seated. However, this implies an external enforcer. If an external enforcer cannot be used, the group may collectively decide ways to punish those who stand. The punishment could range from throwing food at violators to physically assaulting them. The key is to make the commitment credible.*
19. A rivalry exists between the U.S. jet producer Boeing and the European jet producer Airbus. Each government has the opportunity to subsidize its jet producer to give it a competitive edge in the global market. Using game theory, explain what you would expect to observe in practice.  
*Both countries would subsidize their producers. However, this costs money and lowers the price of jets for the rest of the world without either firm ultimately receiving a competitive advantage (the same outcome for both firms if there were no subsidies at all). This is another example of the prisoner's dilemma game.*